

FINAL REPORT

PREPARED FOR

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONTRACT NO. NAS 8-26383

BY

GENERAL ELECTRIC COMPANY

AEROSPACE ELECTRONIC SYSTEMS

UTICA, NEW YORK 13503

(NASA-CR-120728) DC-DC CONVERTERS Final
Report (General Electric Co.)

N75-21513

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Unclas
19526

10/28/74

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DC-DC CONVERTERS - FINAL REPORT

GENERAL

Ten (10) DC-DC Converters were shipped on August 16, 1974. The units shipped were:

+ 28 VDC	Quantity 4
+ 15 VDC	Quantity 3
- 15 VDC	Quantity 3

The different voltages were supplied at the request of NASA.

ELECTRICAL

A major problem was encountered during final testing. Operation of the converters at +85°C (ambient) resulted in Q1 and/or Q2 shorting after 30-60 minutes. This shorting apparently was induced by secondary breakdown.

Investigation revealed that the flatpack inside of the assembly was reaching approximately 105°C indicating T1 was exceeding 105°C. The core of T1 was a magnetic H material. A ZH42206TC core was being used in place of the ZH42908TC core specified by NASA because of the higher efficiencies obtained during the bread-board phase with the 42206 core (see Progress Report #6). H material cores have a curie temperature of 150°C minimum. It was determined that the temperature of the T1 core inside the flatpack was sufficient to reduce the permeability of the core to the point where Q1 and/or Q2 shorted.

The most logical choice to correct this problem was to use F material which has a curie temperature of 250°C minimum and is well suited for this application. The delivery of F material cores was prohibitive (six (6) months), however.

G material cores with a curie temperature of 180°C minimum are readily available and were obtained. The substitution of a ZG42206TC core for T1 core corrected the shorting problem and resulted in satisfactory performance at +85°C.

As a result of the shorting problem, sufficient 2N3749 transistors for Q1 and Q2 for ten (10) converters were not available and again delivery time was prohibitive. To facilitate delivery, an internally fabricated GE transistor (GE Dwg. No. 7536760) was used. Ten (10) copies of the above drawing are attached to this report.

Test data of the ten (10) units shipped is as follows:

A. +28VDC Converters

	Temp. °C	E _{IN} (Volts)	I _{IN} (Amps)	P _{IN} (Watts)	E _O (Volts)	I _O (Amps)	P _O (Watts)	EFF (%)	Freq. (KH _z)
1.	+25°C	26.98	1.99	53.69	28.0	1.75	49.0	91.2	40
2.	+25°C	28.30	1.88	53.20	28.0	1.75	49.0	92.1	50
3.	+25°C	28.44	1.89	53.75	28.0	1.75	49.0	91.1	48
4.	+25°C	27.21	1.97	53.60	28.0	1.75	49.0	91.4	40

/

ELECTRICAL (Continued)

B. +15VDC CONVERTER

	Temp. °C	EiN (Volts)	IiN (Amps)	Pin (Watts)	Eo (Volts)	Io (Amps)	Po (Watts)	EFF (%)	Freq. (KHz)
1.	+25°C	30.48	1.70	51.82	15.0	2.8	42.0	81.0	50
2.	+25°C	30.92	1.65	51.18	15.0	2.8	42.0	82.1	50
3.	+25°C	29.82	1.72	51.29	15.0	2.9	43.5	84.8	50

C. -15VDC CONVERTER

	Temp. °C	EiN (Volts)	IiN (Amps)	Pin (Watts)	Eo (Volts)	Io (Amps)	Po (Watts)	EFF (%)	Freq. (KHz)
1.	+25°C	29.93	1.69	50.50	-15.0	2.9	43.5	86.0	45
2.	+25°C	30.77	1.70	52.31	-15.0	2.9	43.5	83.2	48
3.	+25°C	29.36	1.77	51.96	-15.0	2.9	43.8	84.3	44

This data correlates with the data supplied with Progress Report #6.

MECHANICAL

The converter is designed to be a unit assembly for 50 to 100 watt power supplies with one to three DC outputs. In the final design, the units would be encapsulated and solder sealed. For testing and modification convenience, the ten (10) units supplied under this contract were neither encapsulated nor sealed.

The outside case is a dip-brazed assembly forming the partitions and shelf without the need for fasteners and/or overlapped sections. Input and output filters are located in the top two sections and are isolated from each other. The leads from these filters pass through close fitting holes to the converter section. This eliminated the need for feed-thru terminals.

The converter section contains a coil sub-assembly and a micro-electronics assembly. The coil sub-assembly contains the pacer core, two resistors, and the main transformer. All external leads enter through terminals in the top of the case which line up with the micro-electronics assembly. The corner posts are used to form the box, mount the micro-electronics assembly and fasten to the base of the package.

The micro-electronic assembly contains a metal heat spreader bonded to an insulated terminal board. The metal plate fastens to the four corner posts of the coil sub-assembly and to the sides of the case using adjustable blocks. Silicone grease is used under the micro-electronics flatpack and also on the adjustable blocks before tightening at final assembly.

The output diodes are discrete devices assembled to the terminal board. Originally, these diodes were to be an array of chips in the microelectronics flatpack since only signal devices were available at contract award. This was changed when power diodes in discrete form became available. Space has been provided for six power diodes.

The input micro-electronics package is designed so that several chip substrates can be lased out of a larger substrate, assembled, burned in and re-assembled by solder attaching with a gold tin preform.

MECHANICAL (Continued) — —


The C1 and C2 filter capacitors are assembled between the terminal board and the coil sub-assembly. Space has been provided for two additional capacitors, if required, in the 100 watt converter.

Copies of the mechanical drawings are attached to this report.

NEW TECHNOLOGY REPORTS

There are no additional reports to be submitted with this contract.

This report completes Contract NAS 8-26383.



Theodore R. Johnson, Program Manager
(315) 797-100, Exts. 7729/7294

DIST TO 2

1 SCOPE

THIS SPECIFICATION COVERS THE DETAIL REQUIREMENTS FOR SEMI-CONDUCTOR DEVICES IN CHIP FORM FOR USE IN HYBRID CIRCUIT APPLICATIONS.

2 REQUIREMENTS

THE REQUIREMENTS OF 7536400 (TRANSISTOR CHIP, POWER, GENERAL SPECIFICATIONS FOR) FORM A PART OF THIS SPECIFICATION. IN CASE OF CONFLICT, THIS DRAWING WILL GOVERN.

PT NO	FIG NO	MANUFACTURER'S IDENT NO	COMMENTS
1	1	AETN2-41A	
2	1	AETN2-41B	

2.1 EXCEPTIONS TO 7536400

CANNED SAMPLES OR DATA NEED NOT BE SUPPLIED.

SUGGESTED SOURCE OF SUPPLY:

GE/AESD
UTICA, NEW YORK

GENERAL  ELECTRIC
AESD • UTICA, N.Y.

SIZE CODE IDENT NO.
A 99971

7536760

SCALE

REV.

SHEET 2

DIST TO

TABLE I

CHIP PROBE CHARACTERISTICS (LTPD = 10%)

CHARACTERISTIC	CONDITIONS	SYMBOL	LIMIT			UNIT
			PT NO	MIN	MAX	
COLLECTOR-EMITTER BREAKDOWN VOLTAGE	$I_C = 30 \mu A$ $R(\text{BASE-EMITTER}) = 2K$	BV _{CER}	P1	160	-	V
			P2	110	-	V
DC - PULSE BETA	PULSE WIDTH - 300 μs DUTY CYCLE = 2% $I_C = 1.0A$, $V_{CE} = 2.0V$	HFE2		55	-	-
BASE-EMITTER VOLTAGE	$I_C = 1.0A$ $I_B = 20 \text{ mA}$	V _{BE2}		-	0.9	V
COLLECTOR-EMITTER SATURATION VOLTAGE	$I_C = 1.0A$ $I_B = 20 \text{ mA}$	V _{CE(SAT)}		-	0.8	V

GENERAL ELECTRIC

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SIZE

A

CODE IDENT NO.

99971

7536760

6

SCALE

REV.

SHEET

3

DIST TO

TABLE II

ELECTRICAL INSPECTION (SEE PARA 6 OF 7536400) LTPD = 20%

CHARACTERISTIC	CONDITIONS	SYMBOL	LIMIT			UNIT
			T(°C)	MIN	MAX	
COLLECTOR-EMITTER BREAKDOWN VOLTAGE	$I_C = 30 \mu A$ $R(\text{BASE-EMITTER}) = 2K$	BV _{CER}	-55°C	-	-	V
			+25°C	P1 160	-	
				P2 110	-	
			+125°C	P1 155	-	
				P2 105	-	
DC PULSE BETA	PULSE WIDTH = 300 μs DUTY CYCLE = 2% $I_C = 4.0A$, $V_{CE} = 2.0V$	HFE1	-55°C	27	-	-
			+25°C	40	-	
			+125°C	-	-	
DC PULSE BETA	PULSE WIDTH = 300 μs DUTY CYCLE = 2% $I_C = 1.0A$, $V_{CE} = 2.0V$	HFE2	-55°C	31	-	-
			+25°C	55	-	
			+125°C	-	-	
BASE- EMITTER VOLTAGE	$I_C = 4.0A$ $I_B = 200 \text{ mA}$	V _{BE1}	-55°C	-	1.30	V
			+25°C	-	1.2	
			+125°C	-	-	
BASE- EMITTER VOLTAGE	$I_C = 1.0A$ $I_B = 20 \text{ mA}$	V _{BE2}	-55°C	-	1.0	V
			+25°C	-	0.9	
			+125°C	-	-	
COLLECTOR-EMITTER SATURATION VOLTAGE	$I_C = 1.0A$ $I_B = 20 \text{ mA}$	V _{CE(SAT)}	-55°C	-	-	V
			+25°C	-	0.8	
			+125°C	-	-	

GENERAL ELECTRIC

AESD • UTICA, N.Y.

SIZE

A

CODE IDENT NO.

99971

7536760

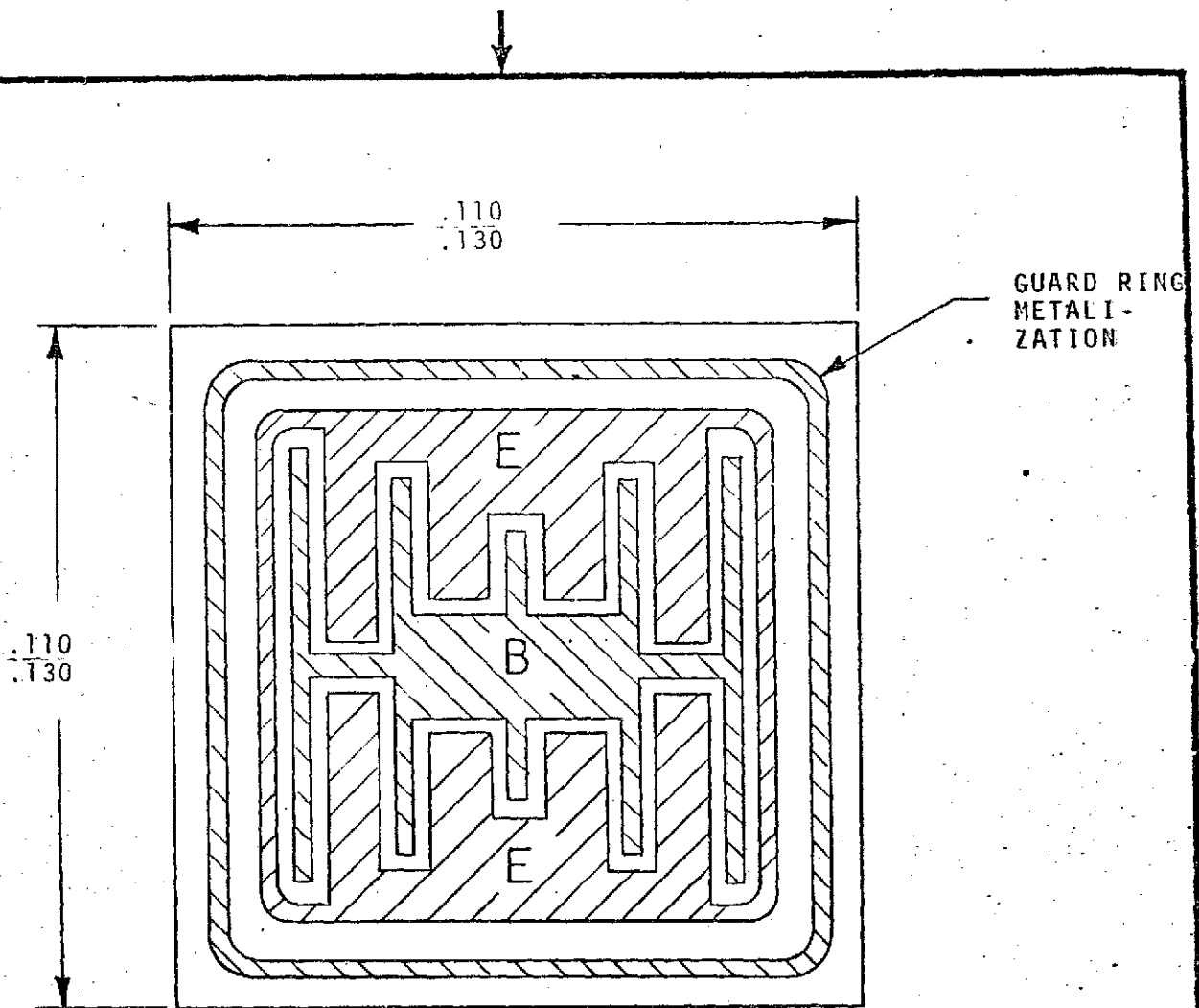
SCALE

REV.

SHEET

4

DIST TO



- 1 CHIP THICKNESS = $\frac{.009}{.005}$
- 2 SURFACE METALIZATION FOR EMITTER AND BASE IS ALUMINUM, 25 KÅ MIN THICKNESS
- 3 BACKSIDE METALIZATION IS GOLD, 4000 Å MIN THICKNESS

AESD10401-F Rev. 6-72

GENERAL ELECTRIC
AESD • UTICA, N.Y.

SIZE CODE IDENT NO.

A

99971

7536760

8

SCALE

REV.

SHEET 5 -

DIST TO

9

SECRET

PARTS LIST FOR

995

WILLIAMS, J. A.

DC/DC CONV

● 2010

CODES: 1. SPEC CONT DWD; 2. PTS NOT DELINEATED ON ASSY, SEE RUNNING LIST
3. PERM ASSM OR MATCHED PTS

GROUP NO. & QUANTITY

UNIT
OF
MEAS

MFC
RTO

[illegible][illegible]

10

2

PARTS LIST FOR		TITLE		GROUP NO. & QUANTITY		UNIT OF MEAS		MFG QTY	
ITEM	CODE	IDENTIFICATION NUMBER	DESCRIPTION OR NAME	ZONE	1	2	3		
1		SK739-421	FRAME		1	1	1		
2		SK739-422	COVER		1	1	1		
3		7736567P24	TERMINAL		4	4	4		
4		SK739-425	TERMINAL BOARD		1	1	1		
5		SK739-426	PLATE-HEAT SINK		1	1	1		
6		SK739-423	BLOCK MTG		2	2	2		
7			# 2-56 FL HD SCR - 3/16 LG		8	8	8		
8			# 2-56 PAN HD SCR - 1/4 LG		4	4	4		
9			# 4-40 PAN HD SCR - 5/16 LG		4	4	4		
10			# 4-40 FLAT HD SCR - 5/16 LG		4	4	4		
11		NP265155	NAMEPLATE		1	1	1		

DISTRIBUTION		REV	REV	REV
1172				1
MADE BY		DTY OF DEPT		PARTS LIST FOR
ISSUED	APPROVAL	LOCATION		COMP ON IN
				SN NO 3

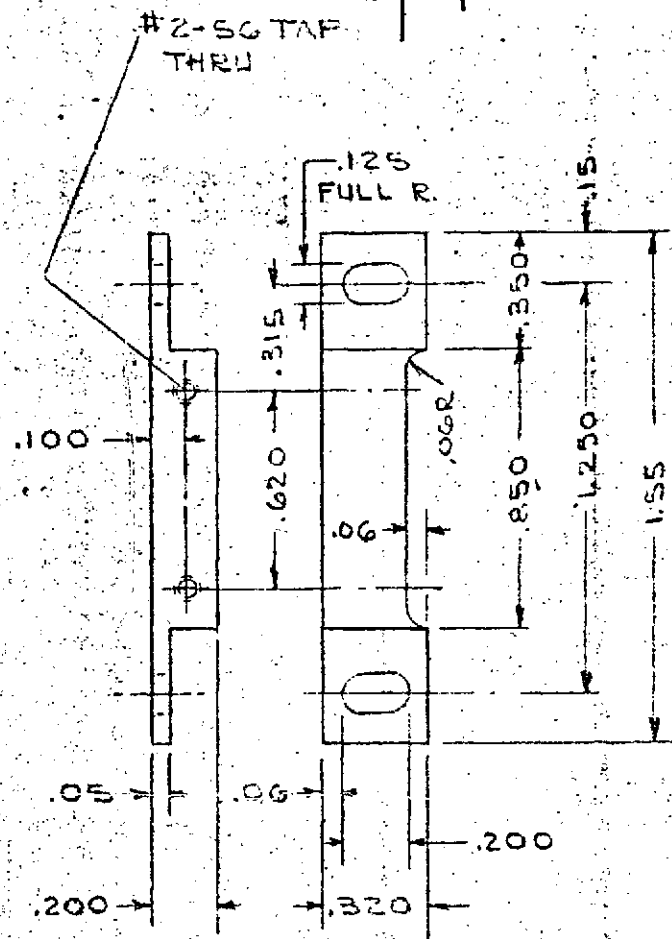
SIZE
A

SHEET

REV

REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
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MAT-ALUM
FINISH-IRRIDITE

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES.
TOLERANCES ON:

FRACTIONS DECIMALS ANGLES
+ - + - + -

ALL SURFACES ☒
MATT.

SIGNATURES

	DAY	MO	YR
DRAWN	4	4	7
CHECKED			
ISSUED			
ENGRG	4	4	7
DPS			
MATLS			

GENERAL ELECTRIC
DEPT LOC

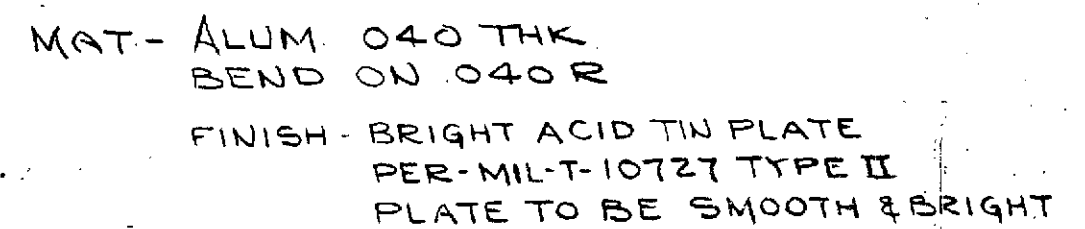
BLOCK, MTG

SIZE A	CODE IDENT NO.	SK739-423
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SCALE 2/1	SHEET	13
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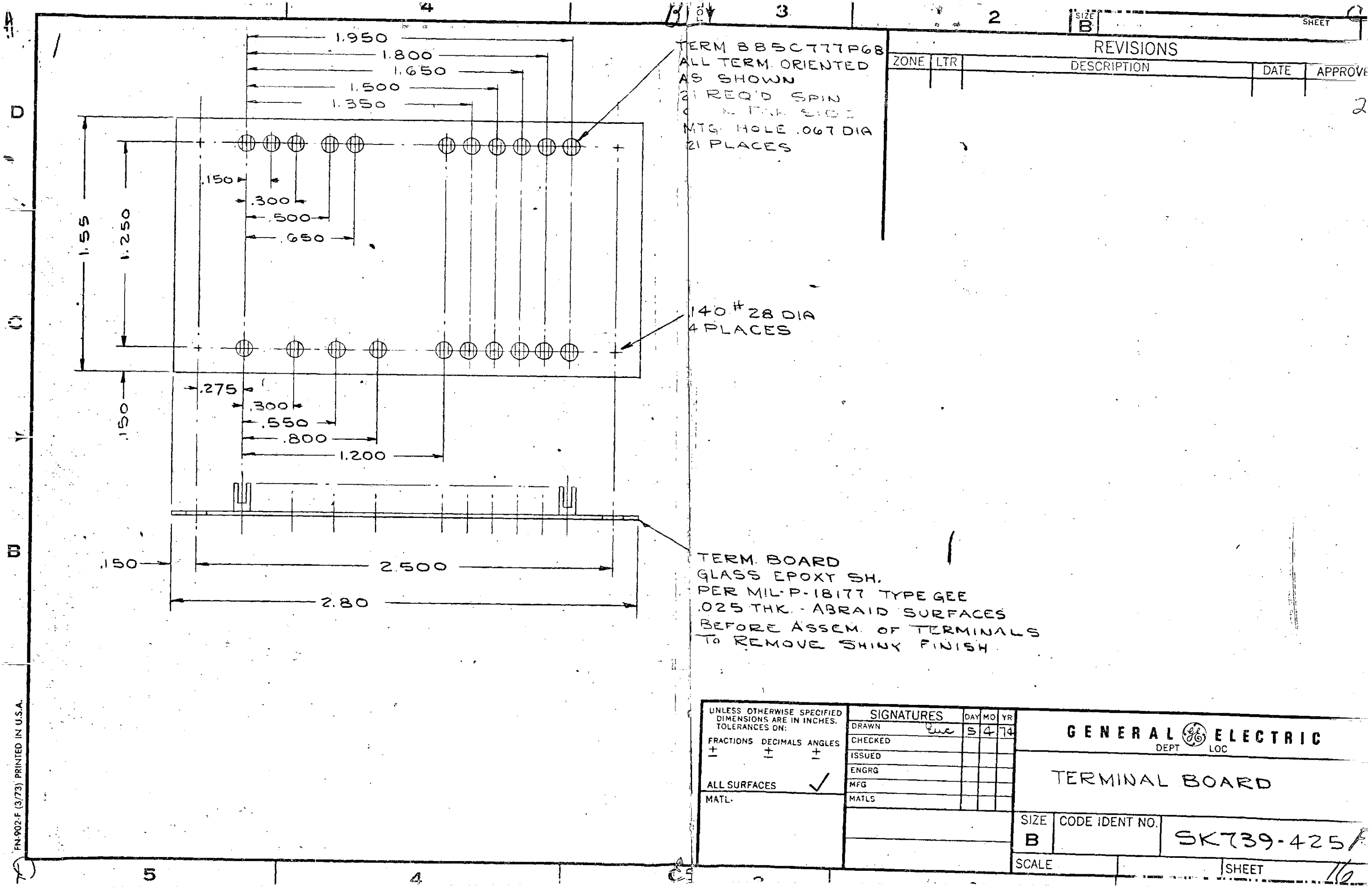
LIST TO

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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON:		SIGNATURES			DAY	MO	YR	GENERAL ELECTRIC	
FRACTIONS DECIMALS ANGLES		DRAWN			3	4	74	DEPT	LOC
±	±	CHECKED						COVER	
		ISSUED							
		ENGRG							
		MFG							
ALL SURFACES	✓	MATLS							
MATL-							SIZE	CODE IDENT NO.	
							B		SK739-422
							SCALE		SHEET 14

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TERM 885C777P68
ALL TERM. ORIENTED
AS SHOWN
21 REQ'D SPIN
1/4 IN. SIDE
MTG. HOLE .067 DIA
21 PLACES

140 #28 DIA
4 PLACES

TERM. BOARD
GLASS EPOXY SH.
PER MIL-P-18177 TYPE GEE
.025 THK. - ABRAID SURFACES
BEFORE ASSEM. OF TERMINALS
TO REMOVE SHINY FINISH

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON:			
FRACTIONS	DECIMALS	ANGLES	
±	±	±	
ALL SURFACES			✓
MATL.			

SIGNATURES			
DRAWN	ENC	DAY	MO YR
CHECKED		5	4 74
ISSUED			
ENGRG			
MFG			
MATLS			

GENERAL ELECTRIC	
DEPT	LOC
TERMINAL BOARD	
SIZE	CODE IDENT NO.
B	SK739-425
SCALE	SHEET
	116

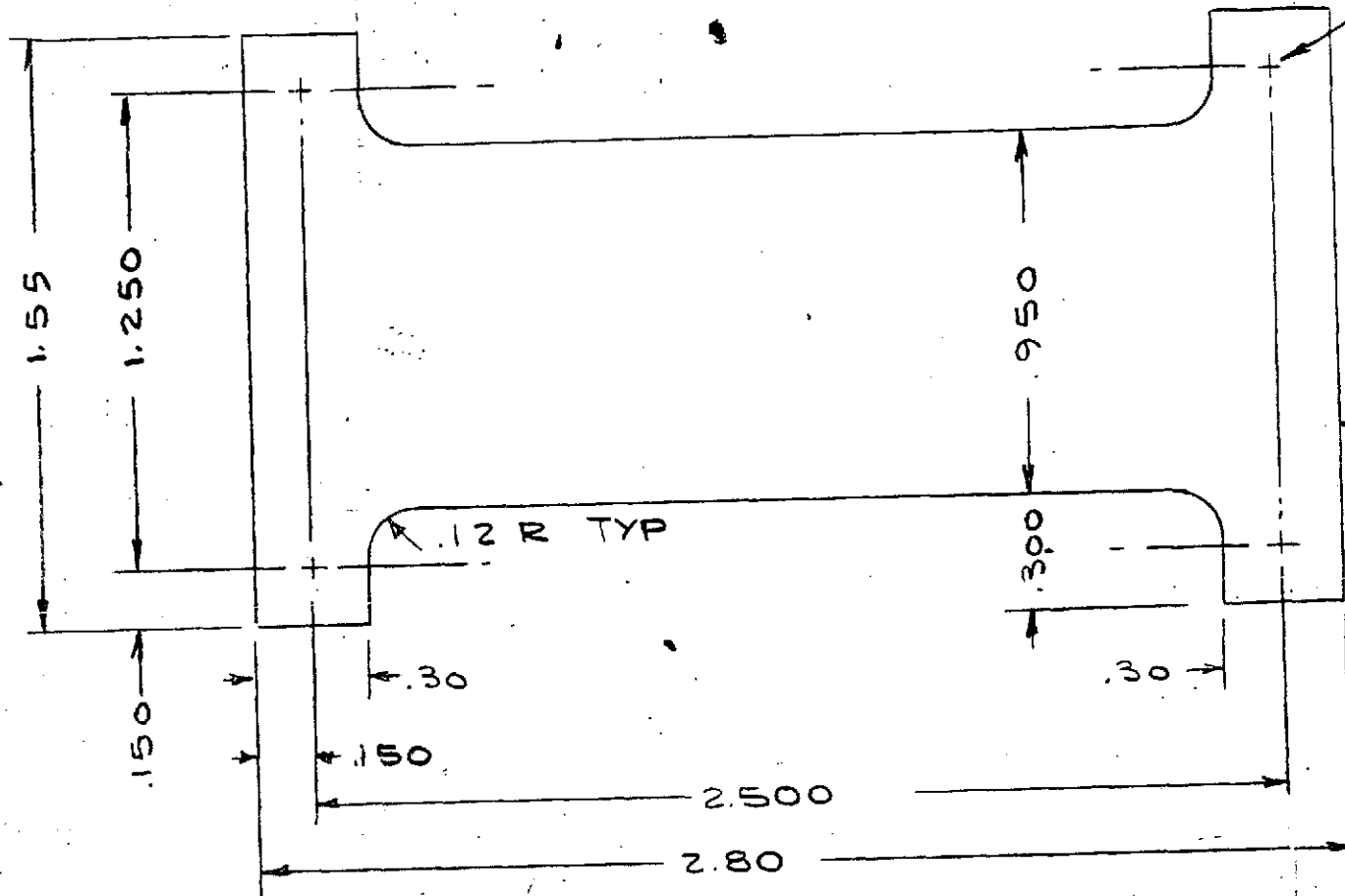
REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED
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2

.140 #28 DIA
4 PLACES

PLATE
ALUM. .040 THK
FINISH - IRRIDITE



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON:		SIGNATURES		DAY	MO	YR	GENERAL ELECTRIC	
FRACTIONS	DECIMALS	ANGLES	DRAWN				DEPT	LOC
±	±	±	CHECKED				PLATE-HEAT SINK	
ALL SURFACES			ISSUED				SIZE CODE IDENT NO.	
MATL.			ENGRG				B SK739-426	
			MFG				SCALE 2/1	
			MATLS				SHEET 17	

GENERAL ELECTRIC										
PART NAME FOR		MICRO PACE INPUT ELECTRONICS								
SK739-427		DC/DC CONV.								
CODES: 1 - SPEC CONT DWG. 3 - PLS NOT DELINEATED ON ASST. SEE PUNCHING LIST 2 - PERM ASSEM OR MATCHED PYS										
ITEM	CODE	IDENTIFICATION NUMBER	DESCRIPTION OR NAME	ZONE	GROUP NO & QUANTITY				UNIT OF MEAS	WTO BTO
C7		2BX050S153K	CAP - VARADYNE 0154E-10V	1						
C8		1BX050S102K	CAP - VARADYNE 0012E-10V	1						
C9		1BX050S152K	CAP - VARADYNE 00154E-10V	1						
CR1		1N3730	DIODE - CHIP	1						
CR2		1N3730	" "	1						
CR3		1N3730	" "	1						
CR4		1N3730	DIODE - CHIP	1						
CR7		1N4449	DIODE - CHIP	1						
CR8		1N4449	" "	1						
CR9		1N4449	" "	1						
CR10		1N4449	DIODE - CHIP	1						
Q1		7536760P1	TRANSISTOR	1						
Q2		7536760P1	TRANSISTOR	1						
Q3		7536760P1	TRANSISTOR	1						

DISTRIBUTION	
1172	

BY	

BY	

MADE BY	
2000-11-74	

BY OR DESI	

PARTS LIST FOR	

APPROVAL	

LOCATION	

COMT ON IN	

18

18

END

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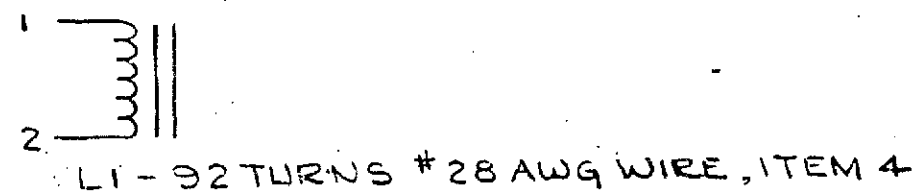
GENERAL ELECTRIC

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PARTS LIST FOR		UNIT		GROUP NO. & QUANTITY		UNIT OF MEAS.	MFG. ETC.
ITEM	CODE	IDENTIFICATION NUMBER	DESCRIPTION OF NAME	ZONE	1	2	
L1		80512-1/40	CHOKER CORE		1	1	
R2		RC32G100JS	RESISTOR (100, 1W)		1	1	
R3		RC32G100JS	RESISTOR (100, 1W)		1	1	
T1		2G42206	TRANSFORMER CORE		1	1	
1		SK739-424	TRANSFORMER HOUSING		1	1	
2		7511287P33	WIRE # 28 AWG		5	5	FT
3		7511287P43	WIRE # 26 AWG		2	2	FT
4		7511287P45	WIRE # 28 AWG		2	2	FT


[illegible]



(G1) WINDING #1 - 36 TURNS START "B" END "B" USE #22 AWG WIRE, ITEM 2
2 - 4 TURNS START "A" END "A" USE #26 AWG WIRE, ITEM 3
3 - 38 TURNS START "A" END "D" USE #22 AWG WIRE, ITEM 2

(G2) SAME AS GROUP 1 EXCEPT -
WINDING #1 - 20 TURNS START "B" END "B" USE #22 AWG WIRE, ITEM 2

WIND BIFILAR-DO NOT TWIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON: FRACTIONS DECIMALS ANGLES \pm \pm \pm ALL SURFACES <input checked="" type="checkbox"/> MATL-	SIGNATURES		DAY	MO	YR	GENERAL ELECTRIC DEPT  LOC		
	DRAWN <i>ew</i>					TRANS. ASSEM		
CHECKED								
ISSUED								
ENGRG								
MFG								
	MATLS					SIZE	CODE IDENT NO.	SK739-455
					B			
						SCALE	SHEET	22

Size
A

SHEET

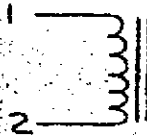
REV

REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
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CORE 55050-A2



30 TURNS # 20 AWG WIRE 7511287 P37

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES.
TOLERANCES ON:

FRACTIONS DECIMALS ANGLES

ALL SURFACES

MATERIAL

SIGNATURES

DAY MO YR

DRAWN	CHECKED	ISSUED	ENGRG	MFG	MATLS

GENERAL ELECTRIC

DEPT LOC

CHOKE

SIZE CODE IDENT NO.

A

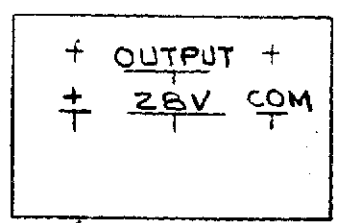
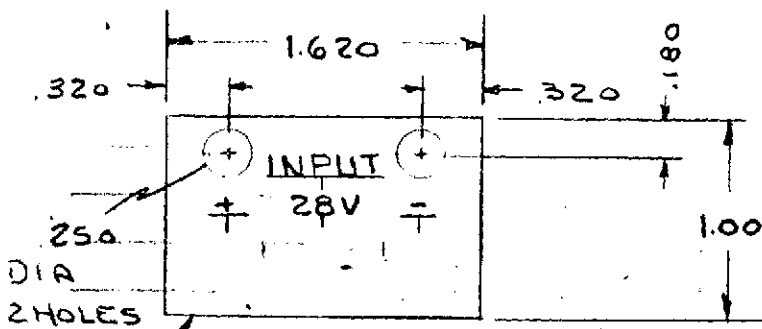
SK 739-456

SCALE NONE

SHEET

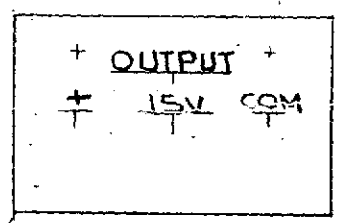
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LIST TO

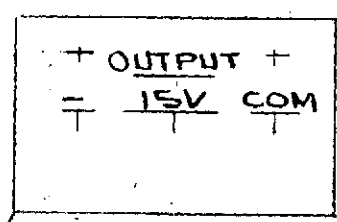


1 MARK AS SHOWN
CHAR .093 HI

2 SAME AS PTI EXCEPT
FOR MARKING.



3 SAME AS PTI EXCEPT
FOR MARKING



4 SAME AS PTI EXCEPT
FOR MARKING

MARKING
DC/DC CONV *24*

SK739-457

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